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Ground-Aided Precision Strike

Heavy Bomber Activity in Operation Enduring Freedom

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Foreword

The advent of near-precision weapons, particularly the joint direct attack munition (JDAM)—combined with the flexibility of the heavy bomber—offers the combined/joint force air component commander a new tool to utilize for close air support (CAS) operations. However, Lt Col Eric E. Theisen asserts that this mission goes beyond the support of forces on the ground and should be classified as a new mission, with heavy precise firepower being the maneuver element in the sky, supported by small groups of forces on the ground. Does the coordination between heavy bombers and terminal attack controllers along with employment of near-precision weapons constitute a new mission for the United States Air Force? He proposes calling this mission *ground-aided precision strike (GAPS).*

The use of the heavy bomber during Operation Enduring Freedom (OEF) is just one more chapter on the flexibility of airpower. Bombers in the early stages of the war destroyed the Taliban air force on the ground and the limited air-to-air defenses, as well as disrupting command and control nodes. Orbiting close over problem areas, heavy bombers, guided by ground terminal attack controllers, precisely struck key targets. The bombers were supplying something different than traditional CAS. This new form of warfare used small parties of ground troops in support of the massive firepower that the bombers could provide. Each war is different; and in this case, there were virtually no external threats to the bombers. With total air dominance and the freedom to range over the battlefield at will, utilizing heavy bombers in the *GAPS* role was possible. This combination of the JDAM along with improved communications systems made this new mission a reality. With the success of these operations, Colonel Theisen believes the USAF should initiate doctrine, rules of engagement, and training changes to accommodate this mission.

As with all Maxwell Papers, this study is provided in the spirit of academic freedom, open debate, and serious consideration of the issues. We encourage your responses.

BENTLEY B. RAYBURN
Major General, USAF
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About the Author

Lt Col Eric E. Theisen is a graduate of the Air War College, Class of 2003. Prior to his current assignment, he served as the commander of the 393d Bomb Squadron, 509th Bomb Wing, at Whiteman Air Force Base (AFB), Missouri, and served as an operations officer and instructor pilot flying the B-2 stealth bomber. He has completed tours at Vance AFB, Oklahoma; Griffiss AFB, New York; Holloman AFB, New Mexico; and Edwards AFB, California. Colonel Theisen entered the Air Force as a Distinguished Graduate from Embry–Riddle Aeronautical University in 1983. He is a command pilot with more than 5,100 hours in the B-2, F-16, F-15, C-23, B-52, T-37, and T-38. He was hand selected for a SAC/TAC exchange tour and the B-2 Initial Operational Test and Evaluation team. He holds a Master of Science in aviation science from Embry–Riddle Aeronautical University and is a graduate from Air Command and Staff College. Following graduation from Air War College, Colonel Theisen was assigned to the J-3 division on the Joint Staff at the Pentagon.

Ground-Aided Precision Strike

Heavy Bomber Activity in Operation Enduring Freedom

If you had offered the B-1 with JDAMs in direct support of ground forces as a solution 10 years ago, I would have laughed heartily because it's not what we envisioned.

—Maj Gen Daniel Leaf, 2002 Director Operational Requirements for Air and Space Operations

The advent of near-precision weapons, particularly the joint direct attack munition (JDAM), offers the combined/joint force air component commander (C/JFACC) a new tool to utilize for close air support (CAS) operations. In the above epigraph, Maj Gen Daniel Leaf describes how the USAF never envisioned bombers supporting ground troops with this form of CAS. However, this mission goes beyond the support of forces on the ground. This is a new mission in itself, with heavy precise firepower being the maneuver element in the sky, supported by small groups of forces on the ground. The following question is central to this paper: Does the coordination between heavy bombers and terminal attack controllers along with employment of near-precision weapons constitute a new mission for the USAF? A proposed term for this new mission is *ground-aided precision strike (GAPS).*

The current use of the heavy bomber during Operation Enduring Freedom (OEF) is just one more chapter on the flexibility of airpower. The order of battle in Afghanistan was a new way of American war. Bombers in the early stages of the war destroyed the Taliban's small air force and the limited air-to-air defenses, as well as disrupted command and control (C^2) nodes.[1] Starting on 21 October 2001, bombers flexed from flying mostly preplanned target missions to flying missions in support of the Northern Alliance against Taliban troops.[2] Orbiting close over problem areas, airborne bombers—guided by ground terminal attack controllers—precisely struck key targets. But the bombers were supplying something different than traditional CAS. This new form of warfare used small parties of ground troops in support of the massive firepower that the heavy bombers could provide.

The air situation in Afghanistan was different than in past wars; there were no surface-to-air or air-to-air threats to the heavy bombers. With total air dominance, freedom to range over the battlefield at will, utilizing heavy bombers in the *GAPS* role was possible. This combination of the JDAM and new communications systems made this new mission a reality. With success of these operations, the USAF is initiating doctrine, rules of engagement (ROE), and training changes to accommodate this mission. Will future battlefield conditions allow the heavy bombers to be used in this role again? Will future conflicts offer the C/JFACC the opportunity to provide massed precision firepower delivered by our legacy systems to ground forces?

New weapons and improved communications have greatly increased the capability of heavy bomber platforms to execute the CAS/*GAPS* mission. Much has been written about the CAS mission and its history, but little has been written about bombers performing this difficult mission. This paper looks at the utilization of heavy bombers in the CAS/*GAPS* role during OEF and offers recommendations for future employment of these platforms in conjunction with revised ROEs and aircrew training.

Doctrine for Close Air Support

It is important to understand the definitions of doctrine for the CAS mission. The USAF defines doctrine as "a statement of officially sanctioned beliefs and warfighting principles that describe and guide the proper use of air and space forces in military operations."[3] Joint Publication (JP)1-02, *Department of Defense Dictionary of Military and Associated Terms*, describes doctrine as "fundamental principles by which military forces or elements thereof guide their actions in support of national objectives. It is authoritative, but requires judgment in application."[4] In other words, our doctrine is not directive but requires situational awareness or "air sense" in its application.

CAS is described by USAF doctrine in Air Force Doctrine Document (AFDD) 2-1.3, *Counterland Doctrine*, as "air action by fixed and rotary wing aircraft against hostile targets which are in close proximity to friendly forces and which require

detailed integration of each air mission with the fire and movement of these forces."[5] The two key factors when applying CAS have always been the need to provide flexible real-time targeting guidance to CAS aircraft and the need to avoid hitting friendly ground forces in close proximity to the target. CAS as defined by US Army doctrine in Army Field Manual (FM) 100-5, *Operations*, is "missions that support land operations by attacking hostile targets close to friendly forces. CAS missions require positive identification of friendly forces and positive control of aircraft."[6] Joint doctrine describes the CAS mission as "providing firepower in offensive and defensive operations to destroy, disrupt, suppress, fix, or delay enemy forces in close proximity to friendly forces. CAS requires detailed planning, coordination, and training for effective and safe execution."[7]

A common friction point between the doctrines is the fire support coordination line (FSCL). This is defined in JP 3-0, *Doctrine for Joint Operations*, as "control and coordinating measures." The document also states that the FSCL applies to all types of fires and is often the most important fire support coordination measure on air-to-ground operations.[8] The C/JFACC must coordinate on its placement and movement. This will optimize the effects of friendly forces and avoid potential geographic sanctuaries for the enemy.

Another friction point is that the Air Force has definitions for two terms *close proximity* and *detailed integration*, which joint doctrine does not address. Once again, it is up to the C/JFACC to coordinate the definition of these terms with his ground component commander. With a common agreement on these terms, the air and space component can select the proper type and mix of CAS applications. Both Air Force and joint doctrine define two types of CAS requests: preplanned and immediate. The heavy bomber platforms with JDAM are well suited for the preplanned role, and any bomber with remaining munitions can fill an immediate CAS request. During the planning for the 1991 Persian Gulf War, Lt Gen Charles A. "Chuck" Horner developed what became to be known as "Push CAS" to maximize air and space support of the ground component commander.[9] Push CAS is a planned concept where the missions are spaced out to provide 24 hours of air coverage along with the required C^2 procedures to task the missions. With Push CAS, the Air

Force can support the ground commander with "on call" firepower and have a ready and waiting supply of weapons to choose from.[10]

Another issue to address is the concept of kill boxes. Many combatant commanders utilize them in lieu of, or in conjunction with, the FSCL to facilitate expeditious coordination of fires. Kill-box size varies according to the situation; but to employ heavy bombers in this role, the kill boxes will have to be large enough to accommodate the larger turn radius of these platforms or the air operations center (AOC) must be aware that bombers can fly through multiple kill boxes before they drop their ordnance in the correct box. The use of kill boxes represents a first step towards improving the coordination and control measures on the battlefield and will help to take us beyond the linear and synchronized measures of today toward a more fully integrated joint effort tomorrow.[11]

The common theme for the CAS mission is that it requires weapons to be dropped in close proximity to friendly forces, and it needs to be controlled and coordinated to prevent friendly force fire incidents. The introduction of near-precision, all-weather, coordinate weapons have added an additional dimension to CAS employment. This new dimension is *GAPS*, and doctrinal changes are necessary to fully exploit this emerging mission.

JDAM: A Weapon for Our Time

The most important development that makes the *GAPS* mission possible is the JDAM. The GBU-31 JDAM is a guidance kit built by the Boeing Corporation that converts free-fall bombs into near-precision-guided munitions. The kit is attached to existing 1,000-pound (lb) Mk-83 and 2,000 lb Mk-84 dumb bombs. The GBU-31 version 3 incorporates the BLU-109 penetrating bomb body. A 500 lb version is in development. A precursor to JDAM—the Global Positioning System (GPS)-Aided Munition GAM-113 or GBU-37—is a 5,000 lb class-penetrating weapon, which is only carried by the B-2 stealth bomber.[12]

The JDAM kit consists of a strap-on movable tail fin unit, strap-on fixed strakes, and an inertial navigation system

capable of receiving updates from GPS. JDAM provides an all-weather guided weapon capability. Bombers deliver JDAM munitions in a straight and level pass. JDAM has aerodynamic strakes that provide an off-axis and downrange capability for the weapon. The strakes provide enough lift so that when the tail fins move, the bomb can glide to a specific point on the ground, rather than falling wherever gravity and the wind would take it. When GPS updates are available, JDAM can strike targets within its specified circular error of probability (CEP) of 13 meters. During the test program and in actual use, JDAM has consistently dropped within 9.6 meters CEP.[13]

JDAM enables both single-pass multiple-target engagements with individual weapons and single-pass single-target engagements with multiple weapons. JDAM is reprogrammable in flight, allowing the aircrew to adjust target coordinates or use onboard systems to update target location. Depending on the platform used, up to 24 desired mean points of impact (DMPI) can be struck by a single bomber on a single pass.[14] The JDAM/bomber combination is the first system that lets the C/JFACC think in terms of targets struck per single sortie instead of multiple sorties to strike a single target.

One of the lessons learned from earlier air campaigns and OEF is that large stocks of precision weapons are now essential for any modern air campaign. In 1991 the percentage of smart weapons used was 9 percent. This rose to 29 percent during Operation Allied Force, but cloud cover hindered the employment of laser-guided weapons. In OEF smart weapons accounted for approximately 60–70 percent of the weapons dropped, with the majority being JDAMs.[15] In past conflicts, smart weapons were carefully allocated for high-value targets, but the experience in OEF is that many if not the majority of the targets were serviced with a JDAM when they could have been serviced with a more abundant munition. This employment of JDAMs by the targeteers could lead to severe JDAM shortages if this type of thinking is allowed to continue.

To alleviate this problem in the future, the Boeing Company—the sole producer of the JDAM tail kits—has accelerated production of the weapon. By January 2003, there were 17,000 kits in the Air Force inventory. Congress in 2002

boosted funding for the JDAM by $1 billion out of concern that OEF had seriously depleted supplies. The most recent production plan calls for 2,800 JDAM tail kits per month by August 2003. The Air Force plans on buying upwards of 236,000 kits, which include tail kits for all the services.[16]

Bombers

With regard to the bombers at Diego, I could not be happier with their performance. They have broken new ground and their credibility is extremely high. I doubt if very many people know the magnitude of what the bombers have done for air power in general.

—Lt Gen Charles Wald
2001 Commander
Ninth Air Force/CENTAF

A brief discussion on the capabilities of the three current bomber platforms follows to gain an understanding of what each aircraft brings to the fight. The oldest bombers range in age from the 1950s' era B-52 to the more modern B-2. The bomber mission has evolved from Cold War nuclear deterrence to conventional bombing during the Vietnam War and Operations Desert Storm and Allied Force to standoff cruise missile attacks and to precision attacks using new "J"-series weapons. Bombers offer long range, great firepower, and flexibility to the C/JFACC.

B-52H Stratofortress

The B-52H, built in 1961 and modified from earlier series, has been upgraded over its career to carry a variety of weapons. From "dumb bombs" to cruise missiles and to the JDAM, the B-52 has seen it all. The B-52 can carry a variety of mixed payloads. Some combinations include 3 AGM-142 HAVE NAP missiles and 27 Mk-82 500 lb bombs, 13 GBU-31 JDAM and 27 Mk-82s, or 16 CBU-103 wind-corrected munition dispensers (WCMD).[17] (WCMD is a standard cluster bomb unit outfitted with a GPS guidance kit similar to JDAM, which allows the B-52 to drop cluster bombs on coordinates, in a tight pattern.) Other available weapons include the M-117 750 lb bomb, the Mk-84 2,000 lb bomb, the M-129 leaflet dispenser, CBU-89/97 cluster bomb units,

the conventional air launched cruise missile, and Mk-62 Sea mines.[18] Target coordinates can be preplanned or updated in-flight by the aircrew. Future weapons additions include the AGM-154 joint standoff attack weapon (JSOW) and the joint air-to-surface standoff missile (JASSM). Long loiter time and massive firepower allow the B-52 to provide around-the-clock coverage for CAS operations. B-52s are based at Barksdale AFB, Louisiana, and Minot AFB, North Dakota.

B-1B Lancer

The B-1B Bone, as the crews that fly it normally refer to it, was developed in the 1970s and produced in the 1980s. The B-1's speed, large payload, and superior handling qualities make it a key element in a joint force package. The B-1 was first used in combat against Iraq in Operation Desert Fox in December 1998. The B-1 was developed as a dual-role nuclear-conventional bomber and has since been designated as a conventional weapons carrier only.[19] The B-1 is capable of carrying 56 Mk-82 500 lb class weapons and 10 CBU-87 cluster bomb units, or 63 Mk-82 bombs, or 24 GBU-31 JDAMs. Weapons also available for the B-1 include the CBU-89/97, the Mk-84, and Mk-62 Sea mines.[20] Future weapons integration for the B-1 includes the WCMD, JSOW, and the JASSM. Currently, a weapons upgrade program is ongoing that includes improvements in weapons carriage, electronic countermeasures, and improved communications.[21] Like the B-52, the B-1 can bring massive firepower and long time over target to CAS operations. The USAF is consolidating B-1 operations at Dyess AFB, Texas, and Ellsworth AFB, South Dakota.

B-2A Spirit

The B-2A fuses long-range, stealth, firepower, and precision into a single aircraft. Used in a dual role for both nuclear and conventional bombing, the B-2 is the USAF's premier penetrating bomber. The Block 30 aircraft have undergone additional modifications incorporating advanced surface treatments, avionics, and communications upgrades. The B-2 can carry 16 JDAMs or JSOWs in mixed combinations, or eight GBU-37s, or up to 16 JASSMs in internal weapon

bays.[22] These near-precision weapons can be independently targeted, updated in flight, and allow multiple kills per pass. A unique capability of the B-2 is its synthetic aperture radar (SAR) system. This system incorporates the GPS-Aided Targeting System to refine target location. Imaging the target area with the SAR radar, the crew can refine and re-designate the location of the target using a sophisticated map-matching algorithm. The near-photographic quality of the radar image allows the B-2 aircrew to positively identify the target location or flex to emerging aimpoints in a target area.[23]

Although not used in the *GAPS* role during Operation Enduring Freedom, the B-2 has all the communications gear and weapons to be used in a stealthy *GAPS* mission if needed. Assuming that air superiority is obtained to utilize bombers in the *GAPS* role, this mission could be better utilized by the B-1 and B-52. Using the B-2 in a first-night first-strike role to "kick down the door" for follow-on forces would be a better use for this limited asset.[24] A future improvement in the carriage capability of the B-2 is the addition of 80 independently targeted Mk-82 JDAMs. While providing a tremendous capability—two B-2s could drop on 160 DMPIs, this also causes an immense targeting problem for the two-person crew if they need to rapidly modify all the DMPIs in a short amount of time.[25] However, a B-2 with 80 independently targeted JDAMs and long loiter capability could be a formidable force to support forces on the ground. The B-2 is located at only one base, Whiteman AFB, Missouri.

A Brief History of Bomber CAS Operations

Various smaller attack aircraft have historically flown CAS missions. The heavy bomber has shown its flexibility in the past by being utilized for the CAS mission, although CAS is not a primary mission for this fleet. The following discussion will be limited to the use of the modern heavy bomber.

The first use of the B-52 in the CAS role during the Vietnam War was actually an accident. B-52s flying out of U Tapao, Thailand, dropped bombs within the three-kilometer safety zone of a US Marine position.[26] Subsequently, the Marines called for tests utilizing the B-52 in this role, and the

USAF and the Marines jointly came up with procedures and tactics to make this a viable mission for the B-52. Using the Combat Skyspot system, which was a radar control van, the Marines guided effective CAS strikes with the B-52.[27]

Demonstrating the persistence of airpower during the battle for Khe Sanh, B-52s flew from Guam and Thailand and arrived over the Khe Sanh combat base every 90 minutes with more than 2,500 sorties to support the 26th Marine Regiment during the heavy firefight. The B-52 proved it possible to use the bomber in Southeast Asia in tactical support of the maneuvering ground units with some success if preparations were appropriate.[28]

During the Persian Gulf War, B-52s were once again called upon to perform the CAS mission. B-52 crews bombed numerous Republican Guard positions and were occasionally called off preplanned targets to support the ground forces. The Iraqi attack on Khafji is just one example. B-52 crews identified armor columns with onboard radar systems and struck these emerging targets from safe altitudes.[29]

In Operation Allied Force, B-52s were used in the CAS role as airborne alert interdiction (XINT) sorties. These missions were flown in support of the Kosovo Liberation Army against Yugoslavian Police and army (VJ) forces.[30] The XINT concept was born at the USAF Weapons School as a way to halt the ground forces in the vicinity of the FSCL. The B-52s dropped Mk-82, Mk-84, and M-117 munitions in this effort.[31]

The B-1 was first used in combat during Operation Desert Fox. There are no instances of CAS operations performed by the B-1 until Operation Enduring Freedom. Even though heavy bombers were used in a CAS role during various conflicts, there was no extensive or continuing use of the heavy bomber in this role over the years.

Transformational Bomber Operations

Marty Kauchak, writing in the *Armed Forces Journal International*, called the OEF air campaign a revolution in military affairs. "It was the performance of precision-guided munitions and other new technologies and the use of new combat tactics that provided glimpses of the 21st century battlefield."[32] All three heavy bombers saw action

in OEF. The tally of the bombers as of March 2002 was that they flew more than 48 percent of the combat missions in Afghanistan, dropping nearly 7,000 tons of munitions—approximately 75 percent of the OEF total—and damaged or destroyed nearly three-quarters of the planned targets.[33] B-1s and B-52s deployed to Diego Garcia, and B-2s staged out of Whiteman AFB. B-2s struck targets in Afghanistan, performed engine-running crew changes at Diego Garcia, and then returned to Whiteman AFB. B-2s only flew on the first three nights of the air campaign. The B-1 and B-52 have flown all of the bomber XINT and CAS/*GAPS* missions so far in this ongoing operation.

Eighteen B-52s and B-1Bs deployed forward to Diego Garcia in the Indian Ocean just before the start of OEF. Typically, the C/JFACC could count on four sorties per day from the B-1B group and five from the B-52 group. For the first time in combat, both the B-1 and B-52 were equipped with links into a data net that allowed them to receive secure target changes and instructions in flight.[34] Early missions in the campaign were flown with preplanned target coordinates, but that soon changed for the B-1 and B-52. Using capability that Gen John P. Jumper, chief of staff of the USAF, called "transformational," bombers engaged emerging targets called in by small parties of ground troops.[35] Planners scheduled aircraft to be available 24 hours a day for operations within the engagement zone. The AOC changed the flow of aircraft into the engagement zone to strike time-sensitive targets called in by terminal attack controllers on the ground. B-52s at the end of October 2001 were dropping JDAMs on the front edge of the battle area north of Kabul on the Shomali front lines.[36]

By March 2002, B-52s had flown more than 500 combat sorties over Afghanistan. The 20th and 40th Expeditionary Bomb Squadrons flew more than 5,000 mishap-free flying hours in just over 100 combat sortie days. "Five hundred sorties is an impressive milestone," said Col Steven Wolborsky, the 40th Air Expeditionary Wing vice commander.[37] This far exceeded the annual flying hour allocation the unit normally receives back home, and the hours were flown in just four months. The launch reliability rate for the B-52s averaged around 99 percent. To complement the large number of flying hours expended in March, the B-52s had delivered

more than 13 million pounds of munitions since 8 October 2001. The totals exceeded those flown in Desert Storm when B-52s flew a total of 414 missions.[38]

Operations in Afghanistan continue to this day. B-1s and B-52s have supplied the maneuvering heavy firepower supported by US ground forces coming in contact with the remaining Taliban forces. Bombers used JDAMs on 1 July 2002 as the main firepower around the Afghanistan province of Uruzgan, and then again in December 2002 around the Shindand Air Base in southern Herat province.[39] There has been no letup in *GAPS* operations into March 2003. Bombers have continued to provide heavy firepower in attacks on 28 January and as recently as 12 February.[40] Bombers loitered overhead for 12–14 hours, the main show in the operation, once again proving the utility of long-range airpower.[41]

Along with the successes of the bombers in OEF, there were missteps as well. An unfortunate friendly fire incident occurred on 5 December 2001 when a B-52 dropped JDAMs on a friendly position. A terminal controller was calling in airstrikes with a portable lightweight GPS receiver (PLGR) unit as the unit's battery failed.[42] After replacing the battery, the PLGR initialized and displayed the combat controller's current position, not the enemy position. He unfortunately passed this position to the B-52 crew, which inserted the coordinates correctly and dropped a JDAM that killed three US Special Forces members and injured as many as 19 others.[43]

This rapid innovation can bring its own hazards, such as the example above. General Jumper has referred to this kind of warfare as a "whole new realm of thinking."[44] Can we think in terms of a new evolving mission utilizing these capabilities?

A New American Way of War

The ingenuity of young people who put together old and new systems to give us the capability we need to deal with a complex situation in Afghanistan is nothing short of amazing.

—Gen John P. Jumper
USAF Chief of Staff, 2002

On-call air and space power linked to the immediate needs of the ground force commander provided a winning combi-

nation in OEF. A near-perfect example of decentralized execution at its best came when a B-52 put ordnance on target within minutes of the request. Northern Alliance forces on horseback came across a Taliban military outpost with artillery, barracks, and a command post. The outpost was not engaged with the ground force at the time, but the Northern Alliance identified it as a stronghold. The commander requested a strike on the target within the next few days. However, the target lay in a location with engagement zones already established. The terminal attack controller radioed to an orbiting B-52. The B-52 dropped its ordnance within 19 minutes of the request.[45]

Does this constitute a new American way of war? In the recent past, America has fought wars of limited duration and objectives. Relying heavily on airpower to achieve its objectives, the United States has rapidly deployed airpower to be the first in the fight. The heavy bomber coupled with Tactical Air Control Party (TACP) teams on the ground has flourished in OEF. No other capability can bring long loiter times and massive firepower to bear to destroy fleeting enemy targets. Small teams on the ground can call in orbiting bombers to unleash their loads on unsuspecting enemy forces. However, this type of operation requires a permissive environment. The Taliban possessed no air force, had limited air defenses, and was in effect a very weak regime.[46] Small teams on the ground supporting precision strikes from the air could be termed *GAPS*, to differentiate it from traditional uses of CAS.

Terminal Controllers: The Lynchpin for Successful Operations

Bomber *GAPS* operations would not be possible if it were not for the terminal controllers on the ground in the theater of operations. They provided the coordination and direct support to perform effective *GAPS* operations. The air force deploys small TACP teams with army units to serve as ground terminal attack controllers. A small group of special operations forces made a huge impact supporting the troops fighting Taliban forces in Afghanistan. During one engagement, the AOC noticed that the strike teams with air force combat controllers were having a better success rate with air strikes

than the teams without them.[47] In the battle for the Balk Valley in northern Afghanistan, air force combat controllers played a key role in calling in air strikes to reduce the enemy threat and minimize the ground resistance. Bomber JDAM strikes were effectively utilized to clear out the Taliban resistance and gain a foothold for Northern Alliance troops.[48]

Machine-to-Machine Interface

The USAF and the joint community are embarking on a TACP modernization program. When thinking of the TACP mission, the end result— bombs on target—is what people usually think about. However, C^2 coordination—how the weapon gets on the target—is the most important facet of this operation. Interoperability is the key to this mission. TACP requires one standard of equipment to speak to all aircraft, C^2 platforms, the Army, and anyone else on the battlefield. Rapid and accurate information is mandatory, fat fingering of information can cause mistakes. Automation is the key to future employment.

Early in OEF, the terminal strike controllers did not have the capability to pass coordinates to JDAM-equipped aircraft. DOD acquired off-the-shelf Leica GeoSystems Viper laser range finder binoculars to triangulate targets in Afghanistan.[49] This system evolved into what is now known as the Modular Advance Reconnaissance System (MARS), which is a compilation of several components tied together. MARS uses the Viper laser range finder coupled with an upgraded GPS PLGR module called the PLGR+96. The Viper is a fully integrated binocular/range finder with onboard digital magnetic compass and inclinometer. The Viper is capable of a lasing distance from 25 meters to 4,000 meters.[50] The unit runs off of a commercial camera battery. The PLGR+96 is a software upgrade to the current AN/PS-11 PLGR. The GPS converts the laser spot to latitude and longitude. The PLGR+96 is a wide area GPS that allows for autonomous position accuracy to four meters. The terminal controller would then transmit the coordinates via voice radio to the aircraft.[51]

However, the aircraft does not just need a position to destroy the target. In CAS operations there will always be friendly troops in near proximity to the enemy. In order to

bomb the target without killing the friendlies, the aircrew must be in voice contact with the TACP who guides the aircraft to the correct target. In other words, it is not enough just to lase the target and pass the location to the aircrew while calling *GAPS*. The introduction of the MARS equipment along with an interface to transmit the location of the target and the terminal controller position on a moving map display to the aircraft would greatly benefit situational awareness. This capability along with an automatic transmission of the target coordinates into the weapons themselves would greatly reduce input errors by operators. The terminal controller would be able to lase the target and the surrounding terrain. This information along with the terminal controller position on the aircrews moving map display would be an outstanding aid to allow the aircraft to strike the correct target without fear of fratricide. The aircrew could watch their aircraft on a display as it flew to the correct target. Other modifications with the MARS in the experimentation stage include transmitting pictures of the target area along with battle damage assessment after the strike.[52] Inputting errors are fallibilities that can be removed from the system. General Jumper says that data is best fed directly into a weapon and then merely confirmed by the human in the loop. Fat-fingering data, particularly in the cockpit, should be avoided wherever possible.[53]

A proof of concept demonstration to successfully transmit a CAS J-Fire nine-line message from the TACP to a B-52 aircrew so they could correctly read and process the message was accomplished on 18–20 September 2002. The results of the test were successful. Messages transmitted and received included an on-station message to the TACP from the B-52, a J-Fire nine-line message to the B-52, free-text messages both ways, and the transmission of the TACP position on the B-52 moving map display.[54]

This test was conducted by the Air Force Command and Control Battlelab and was called the B-52 CAS enhancement. A spiral development 120-day test phase is being implemented to further validate the concept. This equipment should be installed as soon as possible on all three bombers. All three heavy bombers have the capability to install the moving map display, and they are already equipped with secure radios.[55]

Other ways to identify friendly elements on the ground to aircraft are being developed. A beacon identifying the terminal attack controller is being developed to reduce the chances of friendly fire incidents. This consists of the SMP-1,000 beacon which the B-1 and B-52 are able to paint with their onboard radar systems.[56] The beacon weighs about one pound and is easily carried by TACP personnel. In the case of the B-52, the onboard radar can "see" the SMP-1,000 from 90 miles away with about 1,000 feet of accuracy. This visual ability will help identify the TACP personnel on the ground and reduce the chances of dropping on friendly forces.[57]

Along with the SMP-1,000 beacon, another tracking system is the Grenadier beyond line-of-sight reporting and tracking (BRAT) system. This system consists of a transponder, handheld terminal, small ultrahigh frequency transmit antenna, and a GPS receiver. This system contains components that are currently only mounted in vehicles or helicopters. By providing near-real-time tracking of blue-force units, the system reduces fratricide and gives commanders crucial information such as grid location, speed, direction, and mission status of the aircraft or vehicle. A more portable and compact system is being developed. It is called the mini-transmitter—MTX—system, and it allows commanders to track the locations of dismounted soldiers on the battlefield. Many of these smaller units are being fielded currently in support of OEF. A prototyping effort is underway to downsize the Grenadier BRAT system into the format of the Air Force's combat survivor evader locator, a handheld system that uses satellites and military GPS to aid in combat search and rescue efforts.[58] The decision to fully develop which system is long overdue. If *GAPS* is to mature, then a positive means for identifying the friendly ground forces to the attacking aircraft is required. A common system that allows the services to talk to one another is necessary. This is the only way to ensure reduction of friendly fire incidents.

Rules of Engagement

CAS has typically been a visual operation. Historically, the controller on the ground has visual with the target and the aircraft delivering the ordnance. The aircraft delivering

the ordnance has a visual with the target and is either talked on to the target or has some other visual indication of the target's location. This system could include smoke or phosphorous rockets fired from the supporting forward air control aircraft or a laser spot directed by a terminal strike controller. The JDAM/bomber combination comes with a dilemma; how can a terminal controller on the ground have visual with a bomber at 30,000 to 40,000 feet, miles away from the desired aimpoint? This new situation calls for revised ROEs to support *GAPS*.

After the B-52 friendly fire incident, the Joint Requirements Oversight Council convened an executive steering committee to look into this incident. This committee was cochaired by the USAF and United States Marine Corps and attended by Army, Navy, Joint Staff, Joint Forces Command, and Special Operations Command members. This committee recommended 15 issues and 55 action items.[59] The top three actions included training standardization between the services, equipment interoperability, and a CAS distributed training mission needs statement.

One of the major accomplishments of the conference was the writing of a CAS capstone requirements document (CRD). This document should ensure interoperability as it addresses the concept of operations, architectures, and information exchange requirements. It also provides for threshold and objective requirements along with key performance parameters. JP 3-09.3—the joint CAS tactics, techniques, and procedures (TTP) manual—is in management level coordination and was scheduled to be published in January 2003. In addition to the CRD and TTP manuals, the first joint CAS action plan has been written, approved, and published. Progress is occurring in the development of standardized air liaison officer and joint terminal attack controller training. The Marine Corps is examining methods to leverage the Air Force's TACP modernization program. The CAS community has contributed to the development of the concept for operations for the joint tactical radio system, which includes the joint CAS community in its initial membership for fielding.[60]

A joint CAS symposium at Eglin AFB, Florida, recently concluded, and revised ROEs are being written for incorporation into existing aircraft-series tactics manuals.[61] The

demonstrated value of getting representatives of the joint CAS community together annually to review issues, develop solutions, and share insights should be sustained in the future with additional CAS symposiums. There is great momentum today in the resolution of joint close air support issues—momentum that must be sustained and expanded to include *GAPS*. The biggest problem confronting this new mission is the lack of visibility the ground controller has on the delivering aircraft. New ROEs that addresss this situation must be developed if *GAPS* is to be effective over the battlefield.

New Training Required

A conference was held at Hurlburt Field, Florida, on 11–15 March 2002 to gain the tactical lessons learned during the opening rounds of OEF. The consensus from that conference was that conventional airpower and unconventional ground forces on the nonlinear battlefield did not have an effective process to employ ROEs and fire support measures efficiently and in a timely manner. Each member of a TACP team noted that lack of training by conventional airpower with TACP teams resulted in "on the fly" tactics development. They also noted that TACP teams usually train with one airplane at a time, and it was difficult for them to adjust to the different types of aircraft providing firepower in a short amount of time. Bomber crews mentioned that they did little or no training with TACP teams, the CAS mission, and no training whatsoever for the *GAPS* mission prior to deployment for OEF. It took some time for each community to learn each other's capabilities. The TACP controllers require new training to learn the capabilities of the new J-series weapons. Some targets are JDAM worthy and some are not. Calling for a B-1 to go "Winchester" (drop all weapons) on its first pass is a quick way to deplete the limited numbers of JDAMs in the current inventory.[62]

The Air Force director of operations released an interim CAS TTP message that makes several TTP changes. First, he emphasized the need to use standard J-Fire nine-line message format. Every terminal attack controller that was interviewed in Afghanistan emphasized the need to follow the ba-

sics. The standard briefing ensures both the terminal attack controller and aircrew have the minimum required information. Although there may be circumstances where it is not practical, he did mandate it when using coordinate dependent weapons such as JDAM. Additionally, the read back of the message is mandatory, and target elevation was added to the format. Previously, the aircrew was only required to read back when the terminal attack controller requested it. The message also requires the aircrew to provide the terminal attack controller the coordinates that the aircrew entered into the coordinate dependent weapon. This TTP was added to all applicable unit-level flight crew information files. Changes to mission design series specific multi-command manual 3-1 tactics series will be added in upcoming editions.[63] The J-Fire nine-line format is also a suitable message format for the *GAPS* mission.

Training for bomber aircrews is changing as a result of CAS/*GAPS* operations in OEF. There has not been formal CAS training in either the current B-1B or B-52 bomber initial qualification syllabus besides a few hours of academics. There is a short course on bomber CAS that is offered at the USAF Weapons School. This course consists of about three hours of academics and two airborne missions.[64] Bomber units have been participating in Air Warrior exercises at Nellis AFB, Nevada, that emphasizes CAS missions. Individual bomber squadrons have been instituting units plan for the CAS/*GAPS* mission to catch up their aircrews on this evolving mission. The Air Force is starting an initiative to amend existing initial qualification syllabi for each platform and incorporating training on bomber *GAPS* operations.

Conclusions and Recommendations

We are witnessing a revolution in the technology of war. Power is increasingly defined not by size, but by mobility and swiftness. Influence is measured in information; safety is gained in stealth; and forces are projected on the long arc of precision-guided weapons.

—President George W. Bush

The heavy bombers and near-precision weapons performed and are continuing to perform superbly during Oper-

ation Enduring Freedom. Once again, these versatile platforms and aircrews showed their flexibility and ingenuity by adapting to a new, unrehearsed mission over the skies of Afghanistan. The aircrews are adapting well to this new mission, but there are issues that can be resolved to maximize the capability of the bombers and aircrews.

The work on an effective means to ensure machine-to-machine passing of coordinates must be continued. The friendly fire incidents underscore the necessity for precision in coordinates along with precision inherent in the weapons. A system to relay coordinates directly to the weapons interface is needed to reduce this type of accident. A human in the loop checking coordinates is a better means to ensure the correct position is inputted into the weapon. To address these data link and interoperability issues, the Air Force has created a new position of the deputy chief of staff for warfare integration.[65] Hopefully, this position, along with Joint Forces Command, will be the central coordination element to ensure standardization of future initiatives in *GAPS* operations.

CAS and *GAPS* operations do not care what color of airpower is delivering the weapons. Certain segments of the USAF wanted to break out the use of heavy bombers and term it "bomber CAS." However, at the joint CAS symposium held at Eglin, the Navy and Marine Corps were successful in not letting the Air Force call this by a different name.[66] If heavy bombers are supporting ground troops in the traditional CAS role, then a name change for that aspect is not needed. However, the author proposes to break this out as a new mission. Instead of calling this bomber CAS, let us go a step further. Precision firepower called in by TACPs on the ground should be termed *GAPS* and should require further training and doctrine changes. The situation in Afghanistan was unique; there was not a large-standing opposing army that was conducting maneuvers to bring firepower to bear against our forces. US airpower ranged freely over Afghanistan. The United States had small roving fire support teams trying to track down and isolate the remaining Taliban forces. Airpower was the maneuvering element that was supported by the small fire support teams on the ground. The small ground units have

been instrumental in calling in the precise air strikes. This emerging mission goes beyond the joint definition of CAS.

JDAM has brought a new dimension to the *GAPS* mission. Rules of engagement changes are necessary to allow full-unrestricted use of this capability. Bombers and other aircraft can deliver the JDAM precisely on known coordinates through the weather, miles away from the target. The terminal controller will not have the delivering aircraft in sight. Different ROE that is flexible enough to support JDAM deliveries must be instituted to allow future use of this unique capability. This flexibility will be especially important as smaller, more precise weapons are fielded.

Schoolhouse training for US Marine Corps TACPs, USAF TACPs, and special tactics teams differ because the individual services courses emphasize different training based on the background of those attending the courses. A common end state is required for all schoolhouses. They need to develop a standardized training curricula that produces a forward air controller/terminal attack controller who can direct and control *GAPS* missions and advise the ground unit commander on all matters pertaining to this new mission.

Continued development of a 500 lb JDAM is essential for the *GAPS* mission. The 500 lb class munition will enable strike aircraft to destroy a set of targets with fewer sorties, because they will be able to carry more bombs with each mission. General Leaf remarked, "It enables you to get the desired effects with a smaller warhead, decreasing the potential of unintended collateral damage, and clearly this has a great value in the close air support role."[67] The need for small, flexible, and affordable munitions that provide a level of effort capability for joint forces should be developed. The 250 lb small smart bomb that is under development will fit the *GAPS* nicely.

During Operation Enduring Freedom, the heavy bomber has yet again proved the flexibility of airpower. "The biggest change when you jump from Desert Storm to Kosovo to Afghanistan is the use of the Joint Direct Attack Munition. We now truly have a precision-guided munition that is day/night and all weather."[68] This statement made by Maj Gen Walter E. Buchanan III, director of Operations for the deputy chief of staff for Air and Space Operations, clarifies his point by saying that "close-air support has traditionally been done

by fighters because of its precise nature and because of the danger of dropping bombs in close proximity to friendly troops. However, in Afghanistan, we have changed all the rules."[69] Heavy bombers performing near precision attacks with JDAM has offered the C/JFACC a new tool to use in the war against terrorism. In a future war, if the C/JFACC does not have air dominance over the battlefield, then the use of heavy bombers orbiting overhead for *GAPS* operations may not be possible. However, in past conflicts the United States has gained air dominance; and with it, the United States can expect massive, near-precision firepower from maneuvering bombers supported by tactical air control teams on the ground.

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